Instructions: Answer any 3 questions. All questions are equally weighted.

Requirements:

Release in Exam Venue	No [ ]	Yes [☑]
MCQ Answer sheet	No [☑]	Yes [ ]
Handout	No [☑]	Yes [ ]
Formulae & Tables*	No [☑]	Yes [ ]
Cambridge Tables 2nd Edition**	No [☑]	Yes [ ]
Graph Paper*** A4 Graph Paper 1mm 0.1cm Squared (Standard)	No [☑]	Yes [ ]
Other Materials	No [☑]	Yes [ ]
Graphic material in colour	No [☑]	Yes [ ]

End of requirements.

PTO

Q.1.

(a) The game of *nim* is defined as follows. A number of piles of objects exist at the start of the game. Two players take turns removing items from any pile. On a given move a player can only chose one pile from which to take items. Whichever player goes last, loses.

For the simple case of two piles with 4 and 3 items respectively, draw the game tree and show how the minimax algorithm would proceed. (9)

(b) For the following three approaches, explain with an example how they differ in the order that nodes are visited in a tree:
> Breadth first search
> Depth first search
> Iterative Deepening

Compare the three techniques under the following headings:
> Time complexity
> Space complexity
> Completeness
(9)

(c) Explain the motivations underlying the novelty search approach and explain, with an example domain of your choice, how the approach could be implemented. (7)

Q.2.

(a) Explain the schema theorem in the context of genetic algorithms. What are the key principles of the schema theorem? Discuss the roles of crossover, mutation and selection with reference to the schema theorem. (11)

(b) Given a set of N items each with a corresponding weight and value, outline a mechanism to place some of the items in a number of containers each with a fixed capacity (in weight). The sum of the value of the items chosen should be maximised subject to the constraint that the weight of all the items in a container is not larger than the capacity.

Explain how you would apply a genetic algorithm to find a solution. Your answer should include a description of a suitable fitness function, a suitable representation of the chromosomes, and a description of the operators.
(14)

PTO

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Q.3.

(a) Explain what is meant by speech acts within multi-agent systems. Considering a negotiation setting, provide examples of different types of speech acts that agents could use. (7)

(b) Game theory has been used in a number of domains to model and reason about strategic decision making. Explain, with examples, the following concepts: a dominant strategy, Nash equilibrium. (8)

(c) The prisoner's dilemma has often been studied to explore the emergence of cooperation. Explain the game and outline some mechanisms that have been explored to promote cooperation in populations playing the game. (10)

Q.4.

(a) Explain briefly the importance of *explainability* in artificial intelligence. With respect to deep learning, outline approaches that can be used to provide explanations. (8)

(b) With reference to any existing systems, explain what you would consider to be the main properties of an artificial life system. (8)

(c) Explain the term *ant-colony optimisation* and show with a simple example how ant colony optimisation could be used to find solutions to the travelling salesperson problem. (9)

The End